NUMBERS AND DISTRIBUTIONS OF PEARY CARIBOU AND MUSKOXEN IN JULY 1980 ON PRINCE OF WALES, RUSSELL AND SOMERSET ISLANDS, N.W.T.

Northwest Territories Resources, Wildlife & Economic Development

103-05783/

NUMBERS AND DISTRIBUTIONS OF PEARY CARIBOU AND MUSKOXEN IN JULY 1980 ON PRINCE OF WALES, RUSSELL AND SOMERSET ISLANDS, N.W.T.

A. GUNN

R. DECKER

N.W.T. WILDLIFE SERVICE

File Report No. 38

Contents of this paper may be used only with the permission of the N.W.T. Wildlife Service.

ABSTRACT

In July 1980, we flew a linear transect survey to estimate the numbers and distribution of Peary caribou (*Rangifer tarandus pearyi*) and muskoxen (*Ovibos moschatus*) on Prince of Wales, Russell and Somerset Islands. We estimated 5097±710 (S.E.) caribou on the three islands and suggest that the population is currently stable. We saw only 29 muskoxen on Somerset Island and estimated a population of 1126±276 (S.E.) muskoxen on Prince of Wales Island. Our empirical knowledge of muskox distribution, and the results from surveying preferred habitat, leads us to suggest the population is approximately 850 muskoxen. We suggest the population is stable to slightly increasing and a quota increase from 9 to 15 is recommended.

TABLE OF CONTENTS

ABSTRACT iii

LIST OF FIGURES vii

LIST OF TABLES ix

INTRODUCTION 1

STUDY AREA 4

METHODS 9

RESULTS 15
Caribou 15
Prince of Wales Island 15
Somerset Island 18
Russell Island 20
Muskoxen 22

DISCUSSION 30
Caribou 30
Muskoxen 37

RECOMMENDATIONS 45

ACKNOWLEDGEMENTS 47

PERSONAL COMMUNICATIONS 48

LITERATURE CITED 49

APPENDIX A. Numbers of Peary caribou and muskoxen observed on transect (1.6 km wide) on Stratum I, Prince of Wales Island, July 1980 51

APPENDIX B. Numbers of Peary caribou and muskoxen observed on transect (1.6 km wide) on Stratum II, Prince of Wales Island, July 1980 52

APPENDIX C. Numbers of Peary caribou and muskoxen observed on transect (1.6 km wide) on Strata I and II, Somerset Island, July 1980 53

APPENDIX D. Numbers of Peary caribou and muskoxen observed on transect (1.6 km wide) on Strata III and IV, Somerset Island, July 1980 54

APPENDIX E. Numbers of Peary caribou and muskoxen observed on transect (1.6 km wide) on Russell Island, July 1980 55

APPENDIX F. Survey conditions 56

LIST OF FIGURES

Figure 1.	Prince of Wales and Somerset Islands and Boothia Peninsula	2
Figure 2.	Prince of Wales Island, N.W.T.	5
Figure 3.	Somerset Island, N.W.T.	7
Figure 4.	Locations of caribou observed during a transect survey on Stratum I, Prince of Wales and Russell Islands, N.W.T., July 1980	10
Figure 5.	Locations of caribou observed during a transect survey on Stratum II, Prince of Wales Island, N.W.T., July 1980	12
Figure 6.	Locations of caribou observed during a transect survey on Strata I to IV, Somerset Island, N.W.T., July 1980	13
Figure 7.	Muskoxen located during transect and drainage surveys flown on Prince of Wales Island, N.W.T., July 1980	24
Figure 8.	Route of muskox drainage survey flown on Prince of Wales Island, N.W.T., July 1980 ...	27

LIST OF TABLES

Table 1.	Dates and coverage of aerial surveys on Prince of Wales, Russell and Somerset Islands, July 1980	16
Table 2.	Numbers of Peary caribou and muskoxen (including calves) observed during aerial surveys of Prince of Wales, Russell and Somerset Islands, July 1980	16
Table 3.	Data from an aerial survey of Prince of Wales Island as used to calculate a population estimate of 1+year-old caribou in July 1980	17
Table 4.	A summary of grouping statistics from aerial surveys of Peary caribou on Prince of Wales, Russell and Somerset Islands, July 1980	19
Table 5.	Numbers of calves and total caribou segregated on Prince of Wales, Russell and Somerset Islands, July 1980	19
Table 6.	Data from an aerial survey of Somerset Island as used to calculate a population estimate of 1+year-old caribou in July 1980	21
Table 7.	Data from an aerial survey of Prince of Wales Island as used to calculate a population estimate of 1+year-old caribou in July 1980	23
Table 8.	A summary of grouping statistics of muskoxen on Prince of Wales Island, July 1980	26
Table 9.	Previous linear transect surveys of Peary caribou and muskoxen on Prince of Wales and Somerset Islands, July 1980	34
Table 10.	Estimates of Peary caribou and muskoxen on Prince of Wales, Russell and Somerset Islands, from aerial surveys 1974-76	35

INTRODUCTION

The Peary caribou (Rangifer tarandus pearyi) and muskox (Ovibos moschatus) populations of Prince of Wales, Russell and Somerset Islands (Fig. 1) were almost unknown populations before the mid-1970's. The proposal to construct gas pipeline across the arctic islands in the mid-1970's spawned studies designed to inventorize the wildlife and habitat along the pipeline route which included Prince of Wales, Russell and Somerset Islands. Also, in 1975 the focus of caribou hunting by people of Resolute Bay shifted from Bathurst Island and adjacent satellite islands to Prince of Wales and Somerset Islands as the caribou had almost disappeared from the western Queen Elizabeth Islands including Bathurst (Gunn et al. 1981).

Local knowledge, the 1974-75 surveys (Fischer and Duncan 1976), and searches of sea ice in 1977-80 (Miller et al. 1982) led to the recommendation that, as most of the caribou on Prince of Wales, Russell and Somerset Islands were one population that seasonally ranged between the islands, they should be surveyed as one population (Miller and Gunn 1980). The increase in the harvest of caribou from the three islands to 150-250 in the late 1970's, and the increase in families at the Creswell Bay outpost camp and the camp on Prince of Wales Island established in winter 1981, raised concern about the status of the caribou population. Additionally, information was needed about the status of the muskox population as quotas of 6 and 3 had been allocated to Resolute Bay and Spence Bay, respectively in 1977 and increases were requested.

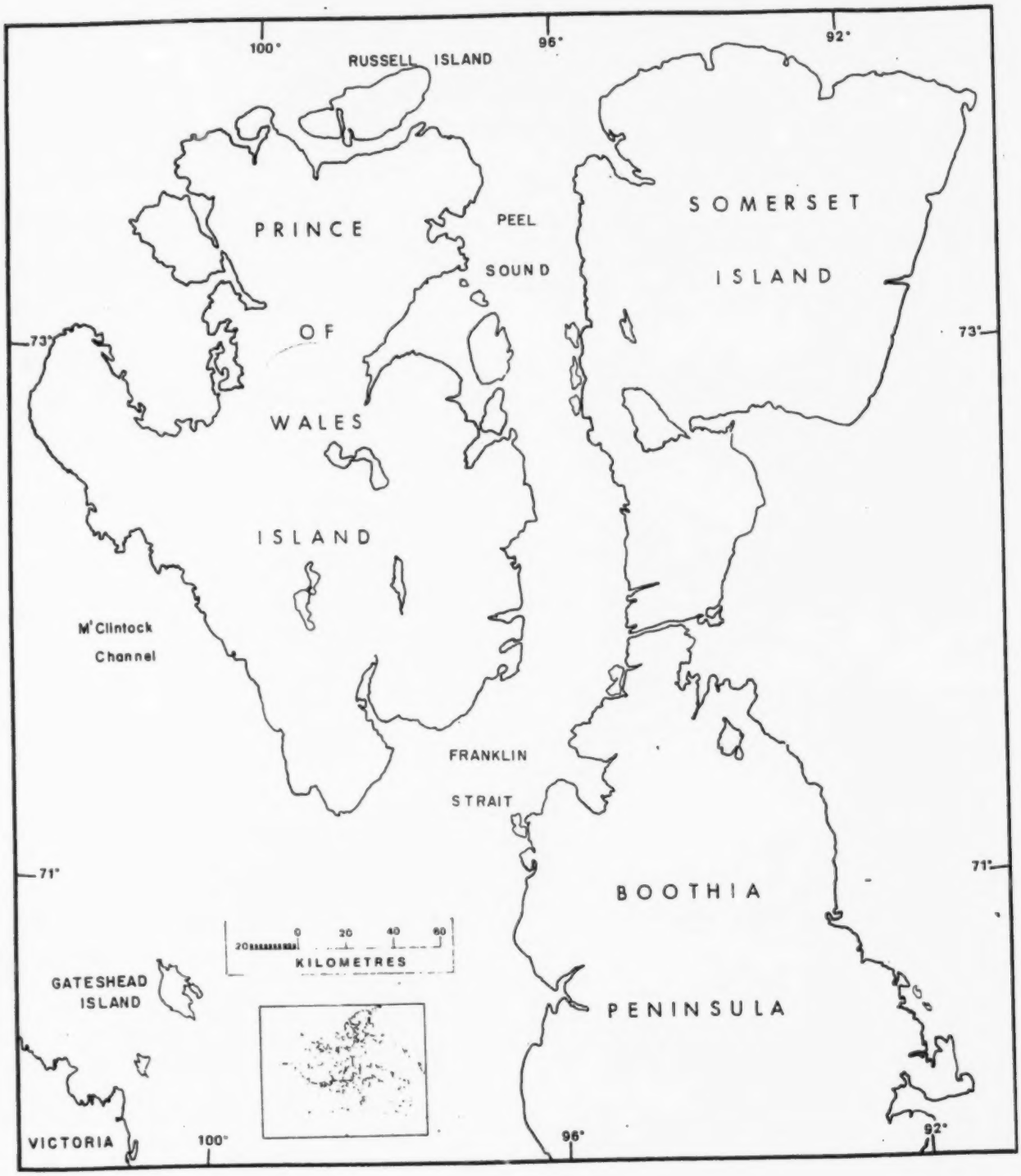

Figure 1. Prince of Wales and Somerset Islands and Boothia Peninsula.

As the three islands were within the areas to be mapped by the Northern Land Use Information Series (NLUIS) program in 1980, we decided to combine a systematic survey of caribou and muskox populations with habitat mapping completed for the NLUIS program. The NLUIS component will be reported elsewhere. The results of the caribou and muskox survey are described in this report.

STUDY AREA

Prince of Wales and Somerset Islands are neighbouring islands separated by Peel Sound. Russell Island lies north across Baring Channel from northern Prince of Wales (Fig. 1). The boundary between the High Arctic and Mid-Arctic Ecological Regions (Woo and Zoltai 1977) runs east-west from Drake Bay to Browne Bay on Prince of Wales (Fig. 2) to north of Stanwell-Fletcher Lake and Creswell Bay on Somerset Island. The vegetation is less sparse in the Mid-Arctic region; rarely is the vegetative cover continuous. The soils have weakly developed horizons.

Woo and Zoltai (1977) used physiography surface materials and soil differences to further categorize the two ecological regions into Ecological Districts. A detailed description of the major plant communities was given by Russell et al. (1978). Woo and Zoltai (1977) only mapped the northern half and Russell et al. (1978) the eastern half. The plant communities and caribou and muskox seasonal ranges described by Russell et al. (1978) do not, as presented, readily coincide with Woo and Zoltai's (1977) Ecodistricts. The NLUIS maps, which were not available at the time of producing this report, will include aerial mapping of major ungulate habitat, though without ground truthing.

The Paleozoic limestones and sandstones of the northeastern uplands (Dunbar and Greenaway 1956) on northern Prince of Wales form rounded hills and wide valleys which grade into the lowlands of northwestern Prince of Wales. The vegetation is a sparse (<30%) cover of Salix arctica, Saxifraga oppositifolia, and

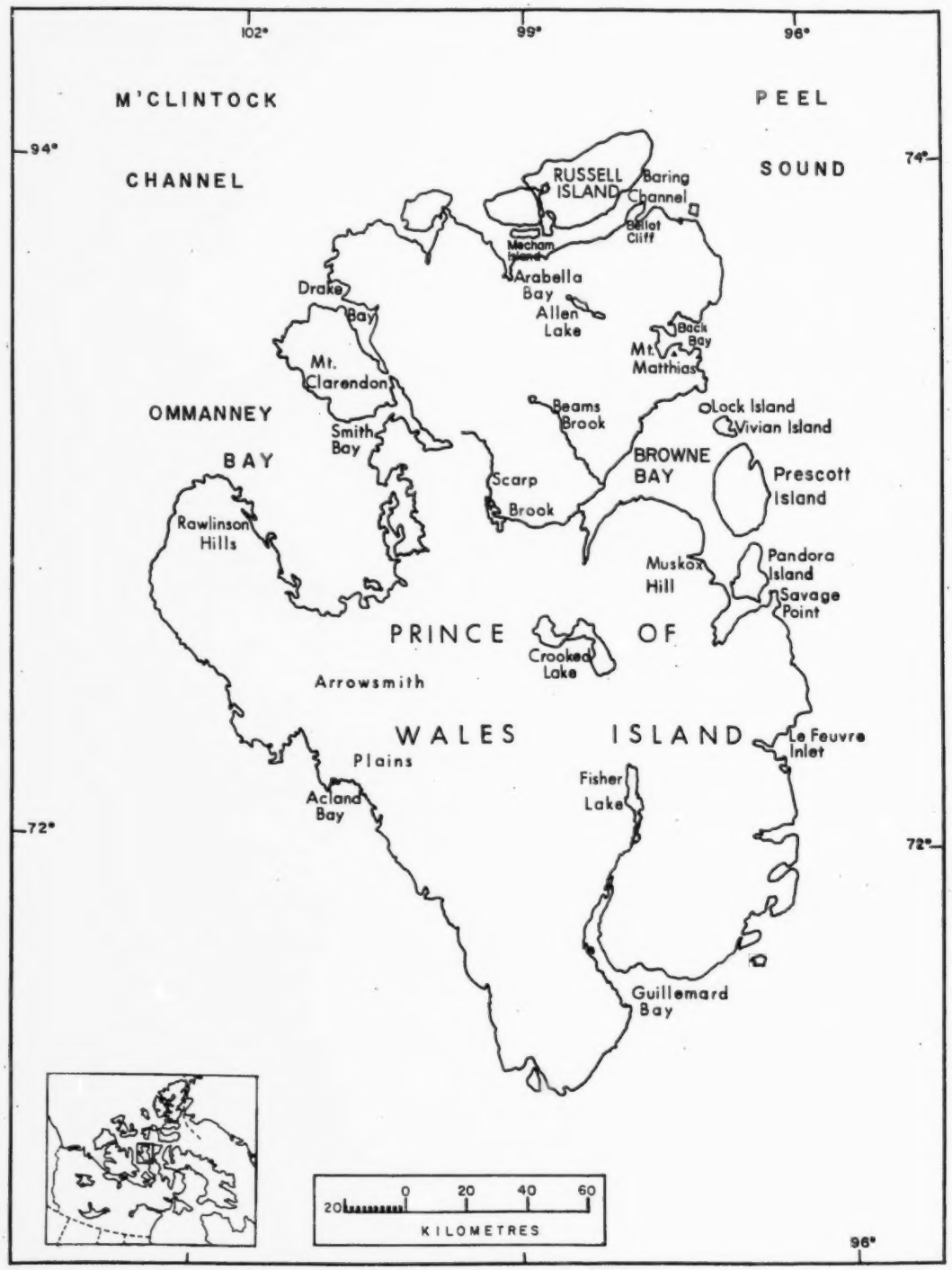

Figure 2. Prince of Wales Island, NWT.

Papaver radicatum. Grasses and willow grow on lower slopes and sedge meadows cover flat areas of fine grained sediments. The northeast upland juts down into southeastern Prince of Wales forming low hills and plateaus with 50-100% Salix arctica, Dryas integrifolia, and grasses and lichens on well drained slopes, and sedge-grass stands on poorly drained areas. The lowlands comprise approximately two-thirds of Prince of Wales Island and include the southwest and central portions of the island. The lowlands are flat or slightly undulating with many raised beaches. S. arctica, D. integrifolia and S. oppositifolia dominate a sparse (5-25%) cover, though moss-grass stands and Carex-Eriophorum meadows characterize poorly drained areas.

Three-quarters of Somerset Island (Fig. 3) is covered by the horizontal limestones and sandstones of the northeastern plateau (Dunbar and Greenaway 1956), which is carved into sections by deeply incised river valleys. The frost patterned ground has almost no vegetative cover. The west coast of Somerset is a continuation of the Precambrian rocks of the Boothia Peninsula. The hills are rugged with deep valleys tending to run north-south. Carex, Luzula and Eriophorum spp. form sedge meadows in the valleys. Cassiope-moss-lichen communities are prevalent mainly on south facing slopes.

The Stanwell-Fletcher basin is a narrow lowland running north-south between the Precambrian upland and the northeastern plateau. The coarse textured till on south facing slopes is covered by Cassiope-moss-lichen communities, and Salix-dominated

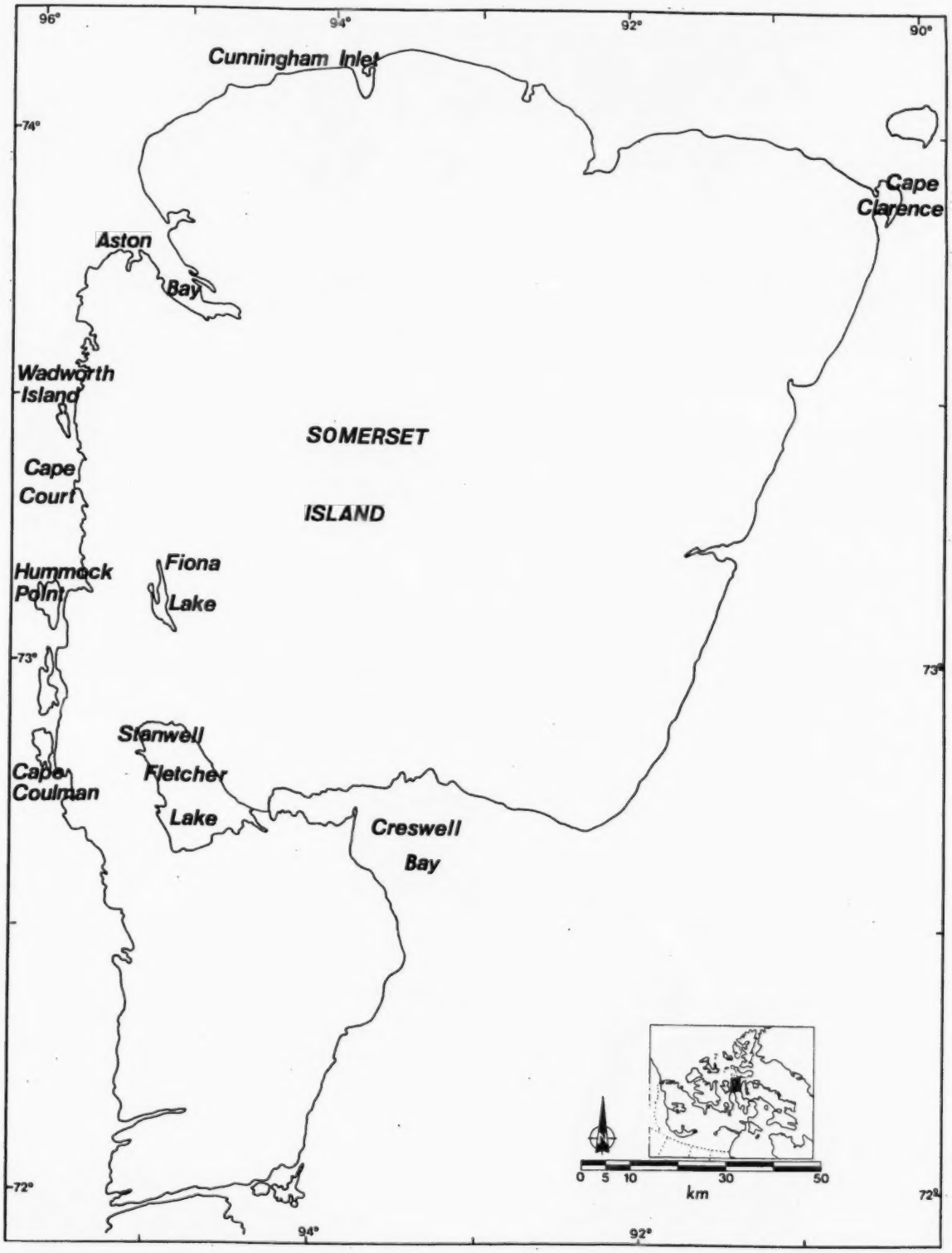

Figure 3. Somerset Island, NWT.

communities form ground cover in excess of 70% on the patterned ground.

The islands were originally inhabited by Thule and Dorset people; but after the Historic period, there had been no settling on Prince of Wales Island except for the brief establishment of a camp at Savage Point in 1958 until an outpost camp was established in 1981. On Somerset Island, the whaler's use of Port Leopold on the northeast corner led to a Hudson's Bay Company's (HBC) attempt to found a trading post in 1926. The attempt was abandoned in 1940 (Treude 1975). Fort Ross, at the southeastern point of Somerset Island, was founded in 1937 as an HBC trading post and seven families, originally from Cape Dorset, were moved there. Difficulties of supplying Fort Ross led to its abandonment in 1948; however, the families left in stages. Treude (1975:57) notes that "With the movement of the last families from Fort Ross in 1970, the coast north from Spence Bay as far as the campsite at Aston Bay became depopulated." The camp at Aston Bay was, in the mid-1970's, used in spring as a base for caribou hunting and char fishing. Two families from Resolute Bay extended the seasonal use of a camp at Creswell Bay in the early 1970's to a year-round camp for char fishing, beluga and caribou hunting (G. Eckalook, pers. comm.).

The nearest weather stations are Resolute Bay and Spence Bay. The differences in the weather between Prince of Wales and Somerset have consequences for movements of the caribou (Miller et al. 1982), primarily because Somerset Island receives greater snowfall than Prince of Wales Island.

METHODS

We used a Helio-Courier fixed wing aircraft on tundra tires to fly a standard "transect census" strip survey of Peary caribou and muskoxen on Somerset, Russell and Prince of Wales Islands. The transects were 1.6 km wide and the 0.8 km strip on each side of the aircraft was divided into an inner and outer strip, each 0.4 km wide. Animals were recorded as being within one of the four, 0.4 km strips or outside the 1.6 km strip (off transect).

As the Helio-Courier has no wing struts, a wire was stretched from an eye-bolt on the fuselage to one on the wing. The wires were marked with two florescent orange and yellow coloured tapes aligned with two pieces of tape on the rear windows. To help the observers judge strip width more easily, two 1.5 m lengths of thin orange or yellow cord were attached to the strip markers on the wires. In flight, the cords streamed out, thus marking the outer edges of the 0.4 and 0.8 km strips. The inner marker of the inner 0.4 km strip was a piece of tape on the wire aligned with the edge of the tire. No calculations were necessary for the blind spot under the aircraft, as a 0.8 km strip was visible from each side of the aircraft. The position of the tape markers was checked against fuel drums positioned at 0.4 and 0.8 km intervals on the ground while flying at the survey altitude of 150 m above ground level (agl). We flew the surveys at 140-190 km/h, depending on the number of animals encountered.

The island was divided before the survey into two strata based on previous knowledge of distribution and numbers of Peary caribou. The north stratum was the area (Fig. 4) north of about

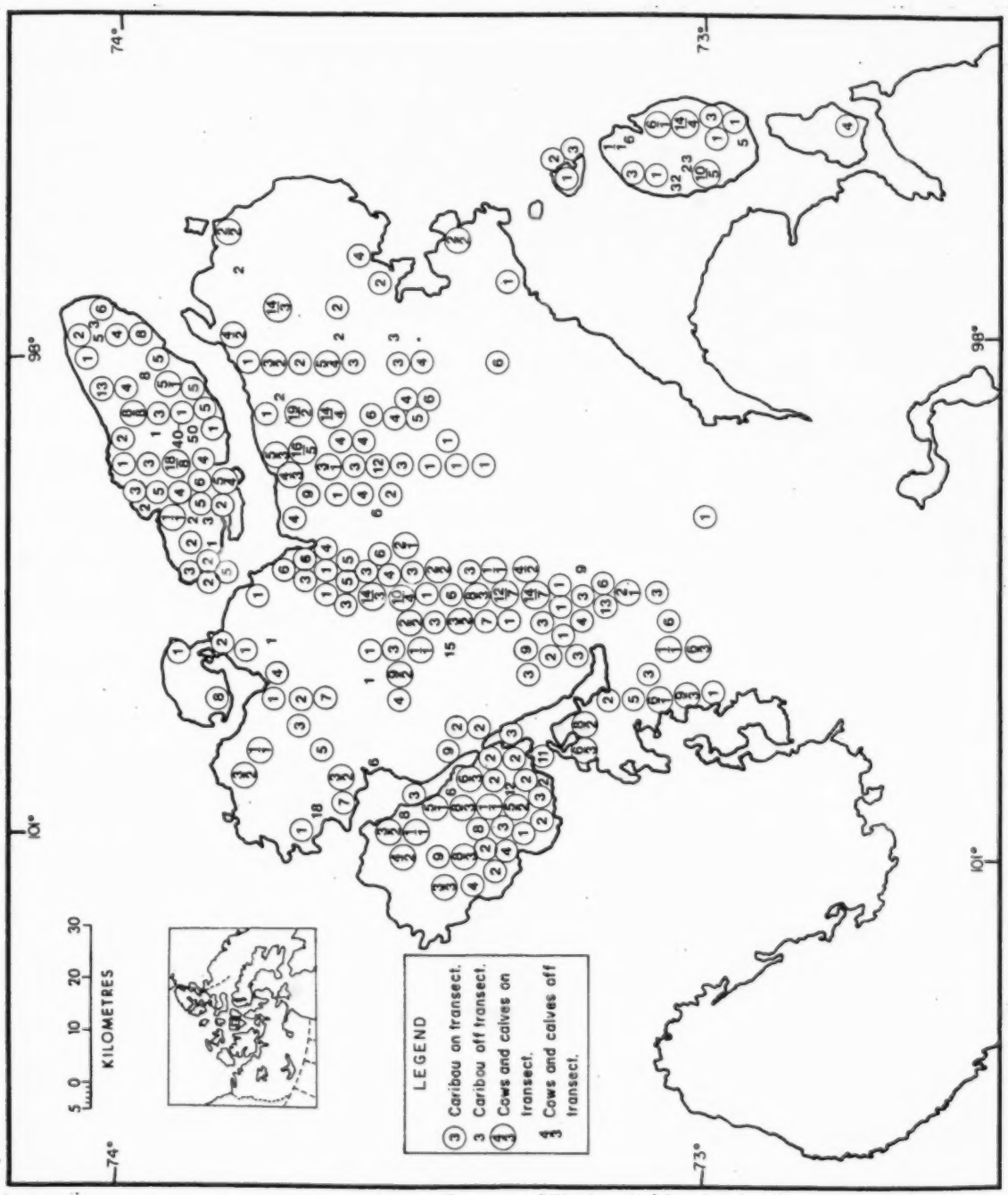

Figure 4. Locations of caribou during a transect survey on Stratum I, Prince of Wales and Russell Islands, July 1980.

73°N, though the actual flight line followed the Scarp Brook escarpment in the east to facilitate navigation (Fig. 2). Stratum II was the area south of 73°N (Fig. 5) and included a small portion of land projecting into Browne Bay at Cape Henry Kellett. The Browne Bay Islands (Lock, Vivian, Prescott and Pandora) were surveyed and their results are included in Stratum I. We divided Somerset Island into four strata (Fig. 6) based on previous knowledge of caribou distribution.

The flight lines were drawn on 1:250,000 scale topographical maps and were aligned north-south except in Stratum III on Somerset, where they ran east-west. We used the Military Grid lines as the flightlines for convenience. In Stratum II on Prince of Wales, the lines were established at 9.6 km intervals. On Stratum I of Prince of Wales and Russell Islands, and Strata II, III and IV of Somerset Island, the coverage was doubled by spacing the lines at 4.8 km intervals as higher densities of animals were expected from previous surveys (Fischer and Duncan 1976). On Stratum I of Somerset the coverage was reduced and the lines were flown at 19.2 km intervals. The pilot acted as navigator and marked the observations on 1:250,000 topographic map by an observations number. The two observers sat in the rear seat and noted observations in field books by the location given by the pilot.

We also flew a drainage and coastal survey for muskoxen on east Prince of Wales. The drainage survey was flown to help evaluate the estimates from the transect survey. The areas of Strata I and II covered by the drainage survey are referred to as substrata I and II. Using previous knowledge and information from

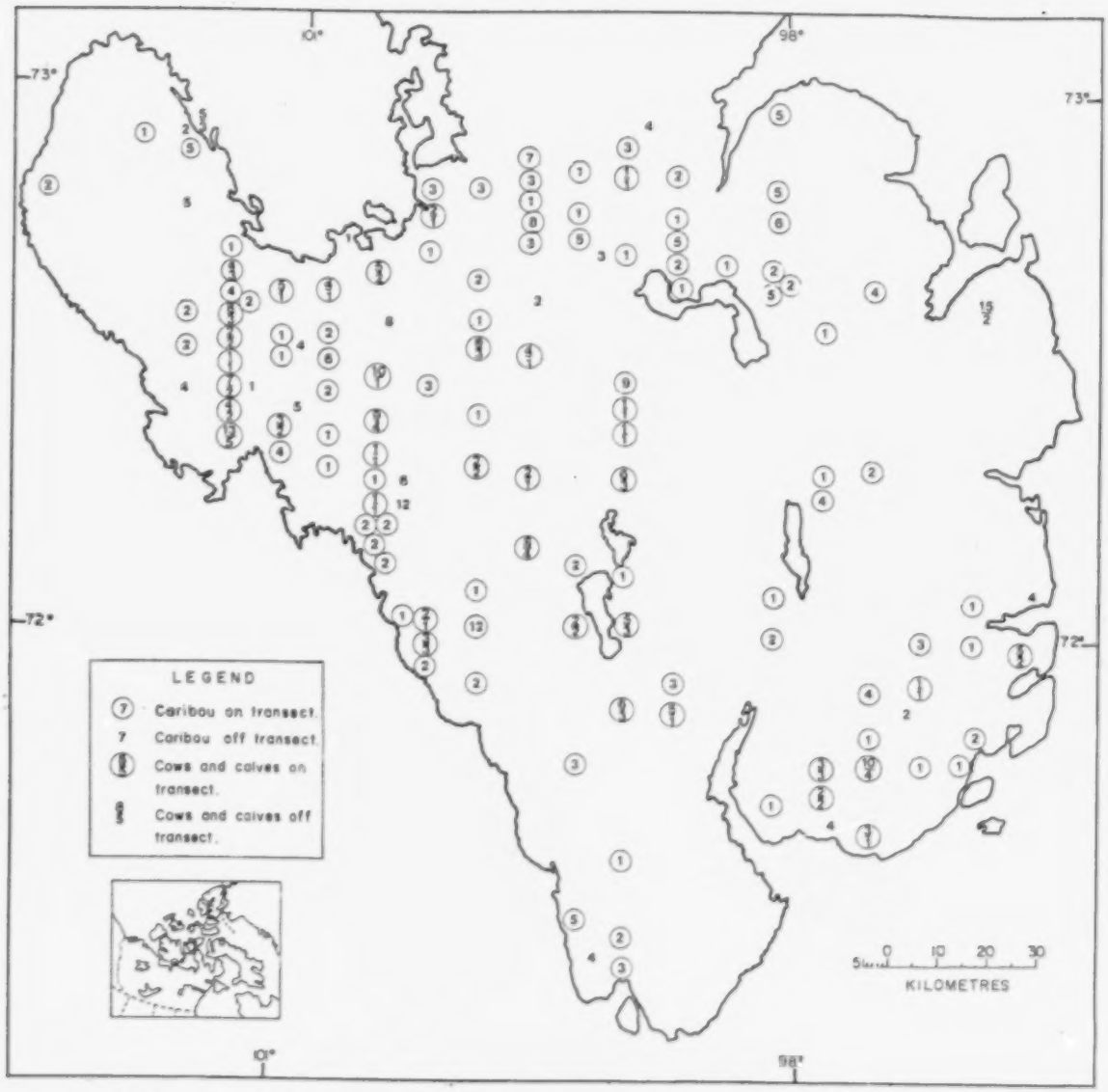

Figure 5. Locations of caribou observed during a transect survey on Stratum II, Prince of Wales Island, NWT, July 1980.

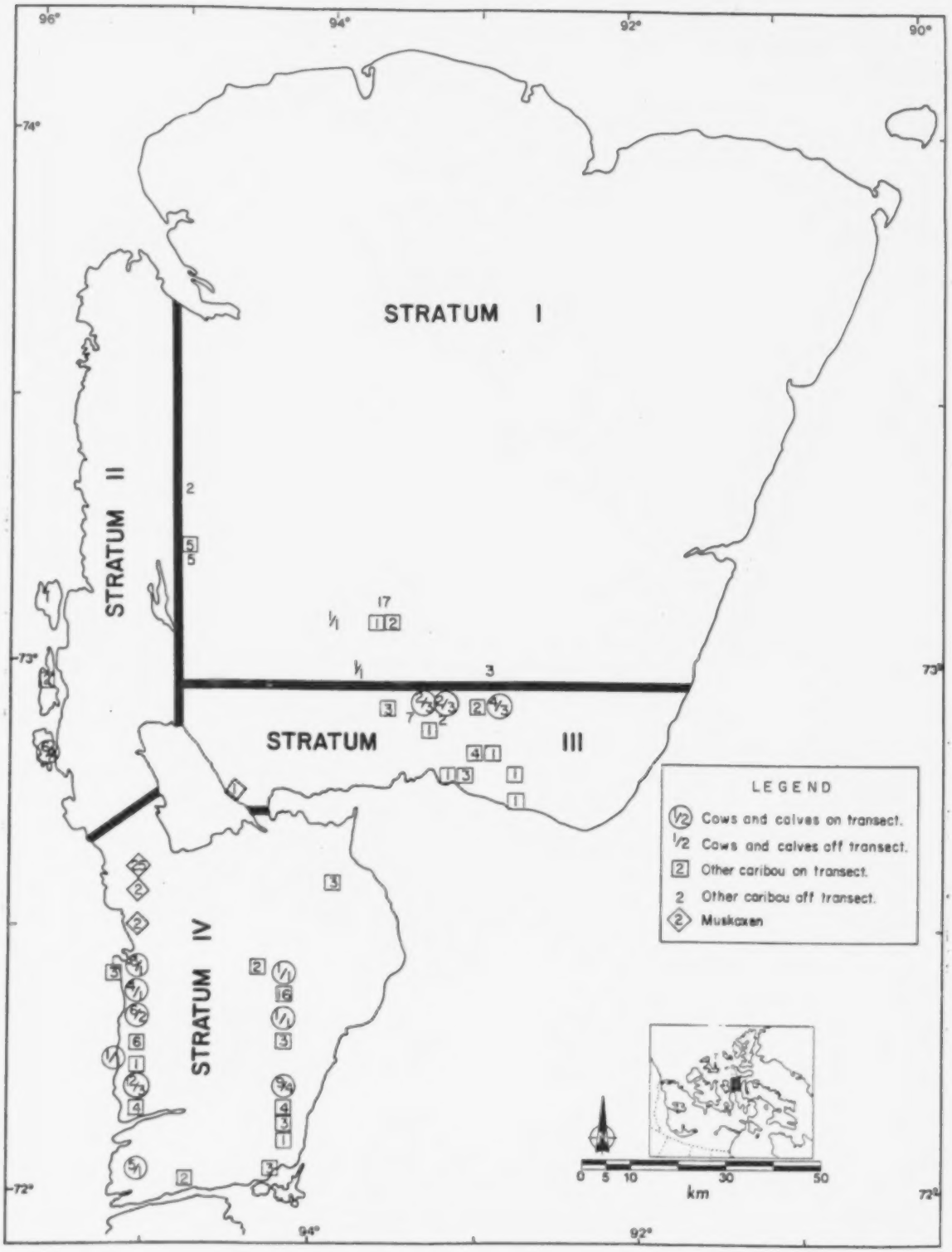

Figure 6. Locations of caribou observed during a transect survey on Strata I to IV, Somerset Island, NWT, July 1980.

the transect survey, we plotted a flightline to cover known areas of muskox distribution. The two observers used binoculars to increase the area observed as transects were not used. The altitude was 300 m agl.

We were based at a Canadian Wildlife Service field camp at Savage Point, Prince of Wales Island (Fig. 2). As well as fuel at Savage Point, we used fuel caches at Crooked Lake, Prince of Wales Island and Fiona Lake, Somerset Island (Figs. 2 and 3).

RESULTS

The surveys of Prince of Wales, Russell and Somerset Islands required about 102 h of aircraft time. Those total hours included 50 h for ferry time to and from Norman Wells as well as ferry time between transects, fuel caches and camps. Between 12 and 22 July, 1980 we flew 6862 km on transect (10,980 km^2), which represented a mean coverage of 20% for the study area (Table 1).

Caribou

Prince of Wales Island

Coverage was 31.2% on Stratum I and 17.5% on Stratum II (Table 1). On Stratum I, we observed a total of 837 caribou, including calves, on and off transect (Table 2). Mean density of the 589 caribou (1+year of age) observed on transect (Appendix A) was 19.0 caribou/100 km^2 on Stratum I compared to 9.0 caribou/100 km^2 on Stratum II, where we saw a total of 533 caribou including 438 counted on transect (Table 2 and Appendix B).

The number of 1+year-old caribou estimated (95% confidence limits) on Prince of Wales Island was 3952±939 (Table 3). About the same proportion of caribou were observed off-transect in both strata: 16.7% in Stratum I and 17.8% in Stratum II. More caribou were counted in the outer 0.4 km strip than the inner. The difference in Stratum II was small: 42% and 40% of the total 533 caribou counted were in the outer and inner 0.4 km strips, respectively. However, in Stratum I, 49% of the caribou were on the outer and 34% on the inner 0.4 km strip.

Table 1. Dates and coverage of aerial surveys on Prince of Wales, Russell and Somerset Islands, July 1980.

Location	Area (km^2)	Days flown (July 1980)	Area surveyed km^2
Prince of Wales	31,686		6,876
Stratum I	9,736	14,15,17,18	3,039
Stratum II	21,950	12,13,14	3,837
Russell	930	14	320
Somerset	23,818		3,784
Stratum I	15,274	22	1,326
Stratum II	2,188	19	737
Stratum III	2,603	19,20	487
Stratum IV	3,753	20,21	1,234

Table 2. Numbers of Peary caribou and muskoxen (including calves) observed during aerial surveys of Prince of Wales, Russell and Somerset Islands, July 1980.

Island and Strata	Animals observed on transect 1.6 km	Animals observed on transect 0.8 km	Animals observed off transect
Peary Caribou			
Prince of Wales			
I	697	288	140
II	438	213	95
Russell	225	115	67
Somerset			
I	10	6	24
II	12	0	1
III	33	6	9
IV	108	76	0
Muskoxen			
Prince of Wales			
I	83	13	88
II	174	99	67

Table 3. Data from an aerial survey of Prince of Wales Island used to calculate a population estimate of 1+year-old caribou in July 1980.

	Stratum		
	I	II	Total
Stratum area km^2	9,736	21,950	31,686
Sampling area km^2	3,039	3,837	6,876
No. possible transects	92	109	
No. transects flown	27	21	
No. caribou counted	589	361	950
Density caribou/km^2	0.19	0.09	
Population estimate	1,887	2,065	3,952
Variance	100,394	123,980	224,374
Standard error	317	352	474
Coef. variation	0.17	0.17	0.12

The caribou in Stratum I (Fig. 4) were distributed mainly in the west and northwest. The three areas of caribou concentration were the northwest peninsula (in this report, referred to as Mount Clarendon - Fig. 2), the broad drainage running southwest from Arabella Bay to Smith Bay (Fig. 2), and the rolling terrain south of Baring Channel. Caribou were more scattered on Stratum II (Fig. 5) but there was some concentration of caribou, especially cow-calf groups, on the Arrowsmith Plains (Figs. 2 and 5).

Mean group size (excluding single caribou) was slightly less in Stratum II than in Stratum I (Table 4). The proportion of groups with calves (including cow-calf pairs) was higher in Stratum II where 40% of the groups (36/89) had calves compared to 31% (45/146) in Stratum I. The proportion of cow-calf pairs was 13% (6/45) and 19% (7/36) in Stratum I and II, respectively.

The proportion of calves averaged 16.3% for both strata on Prince of Wales Island (Table 5). We did not attempt to count yearlings as it is almost impossible from the air.

Somerset Island

Stratum I (Table 1) had the lowest coverage (8.7%) as it is almost totally Polar Desert. The other three strata were surveyed with coverage of 18.7-34% (Table 1). We observed a total of 197 caribou on and off transect (Table 2). Mean densities of 1+year-old caribou were low, especially on Strata I and II (1 caribou/100 km^2) (Appendix C). Mean densities in Strata III and IV were 5 caribou/100 km^2 and 8 caribou/100 km^2, respectively (Appendix D). The number of 1+year-old caribou on Somerset Island was estimated

Table 4. A summary of grouping statistics from aerial surveys of Peary caribou on Prince of Wales, Russell and Somerset Islands, July 1980.

Island/Stratum	No. groups incl. singles	No. singles	Group size excl. singles Mean	Group size excl. singles Range
Prince of Wales				
I	170	24	6.2	2-21
II	118	29	4.7	2-18
Russell	36	8	5.7	2-26
Somerset				
I	4	1	3	2-5
II	2	0	3	2-10
III	10	3	4.1	2-7
IV	22	2	5.3	2-13

Table 5. Numbers of calves and total caribou segregated on Prince of Wales, Russell and Somerset Islands, July 1980.

Island and Stratum	Number of calves	Total caribou segregated (on transect)
Prince of Wales		
I	108	697
II	77	438
Russell	24	225
Somerset		
I	0	10
II	4	12
III	7	33
IV	15	108

(at the 95% confidence level) to be 561±300 (Table 6). However, the precision of the survey was low because few animals were counted. The proportion of caribou observed off-transect varied between the strata (Table 2). This reflects the low numbers seen, as only one or two groups could weight the proportions. Similarly, the proportion of caribou counted on the inner versus outer 0.4 km strip varied considerably. On Strata I and IV, more caribou were observed on the inner 0.4 km strip (Table 2).

The areas of caribou concentrations were the west coast, the coastal plain north of Creswell Bay and a valley running north-south in Stratum IV (Fig. 6). The broken terrain of Strata II and IV, with north-south running rugged valleys, likely influenced the observed pattern of distribution and numbers. The low numbers of caribou counted, except on Stratum IV confound the grouping statistics (Table 4) and proportions of calves (Table 5). The mean group size on Stratum IV (5.3, 2-13) was similar to that on Prince of Wales and Russell Islands. The proportion of calves (13.9%) on Stratum IV was similar to that on Russell Island and slightly less than that on Prince of Wales (Table 5).

Russell Island

Aerial survey coverage of Russell Island was 34.4% (Table 1). We counted a total of 292 caribou including calves, on and off transect (Table 2). The density of 63 caribou/100 km^2 was the highest observed during the survey of the three islands. The population, extrapolated from 201 1+year-old caribou observed on transect (Appendix E), was extimated to be 584±90 (variance 8062,

Table 6. Data from an aerial survey of Somerset Island used to calculate a population estimate of 1+year-old caribou in July 1980.

	Strata				
	I	II	III	IV	Total
Stratum area km^2	15,274	2,188	2,603	3,753	23,818
Sampling area km^2	1,326	737	487	1,234	3,784
No. possible transects	93	18	18	35	
No. transects flown	8	5	6	12	
No. caribou counted	10	8	26	93	137
Density/km^2	0.01	0.01	0.05	0.08	
Population estimate	115	24	139	283	561
Variance	6,049	808	828	13,639	21,324
Standard error	78	28	29	117	146
Coef. variation	0.68	1.2	0.21	0.41	

c.v 0.22). The caribou were distributed over the whole island (Fig. 4), but with fewer caribou in the north central area. Two large groups of cows and calves were seen (26, 40-50); however, the mean group size of 5.7 was similar to that on Prince of Wales Island (Table 4). The 225 caribou counted on transect included 10.7 % calves (Table 5).

Muskoxen

We counted a total of 171 and 241 muskoxen on and off transect in Strata I and II, respectively, on Prince of Wales Island (Table 2 and Appendices A and B). We counted one group of 25 muskoxen (one short yearling, no calves) and two groups of two bulls each southeast of Stanwell Fletcher Lake on Somerset Island. We did not see muskoxen on Russell Island.

On Prince of Wales Island, the density of muskoxen was 2.0 and 4.0 muskoxen/100 km^2 on Strata I and II, respectively. The population estimates (Table 7) were 234 on Statum I and 898 on Strata I and II (excluding calves). The standard errors of the estimates are relatively high (Table 7) because of the clumped distribution of the muskox groups. The estimated number of muskoxen on Prince of Wales Island is 1126 ± 276 (S.E.). More muskoxen were counted in the outer 0.4 km strips in Stratum I (Table 2); only 15.7% of the muskoxen counted were in the inner 0.8 km.

The muskoxen observed were concentrated on the coastal flats and drainage areas of eastern Prince of Wales Island east of Crooked Lake (Fig. 7). In Stratum II only one group of mixed

Table 7. Data from an aerial survey of Prince of Wales Island used to calculate a population estimate of 1+year-old muskoxen in July 1980.

	Strata		Total
	I	II	
Stratum area km^2	9,736	21,950	31,686
Sampling area km^2	3,039	3,837	6,876
No. possible transects	92	109	
No. transects flown	27	21	
No. muskoxen counted	73	157	
Density muskoxen/km^2	0.02	0.04	
Population estimate	234	898	1,126
Variance	16,619	59,416	76,035
Standard error	129	244	276
Coef. variation	0.55	0.27	0.25

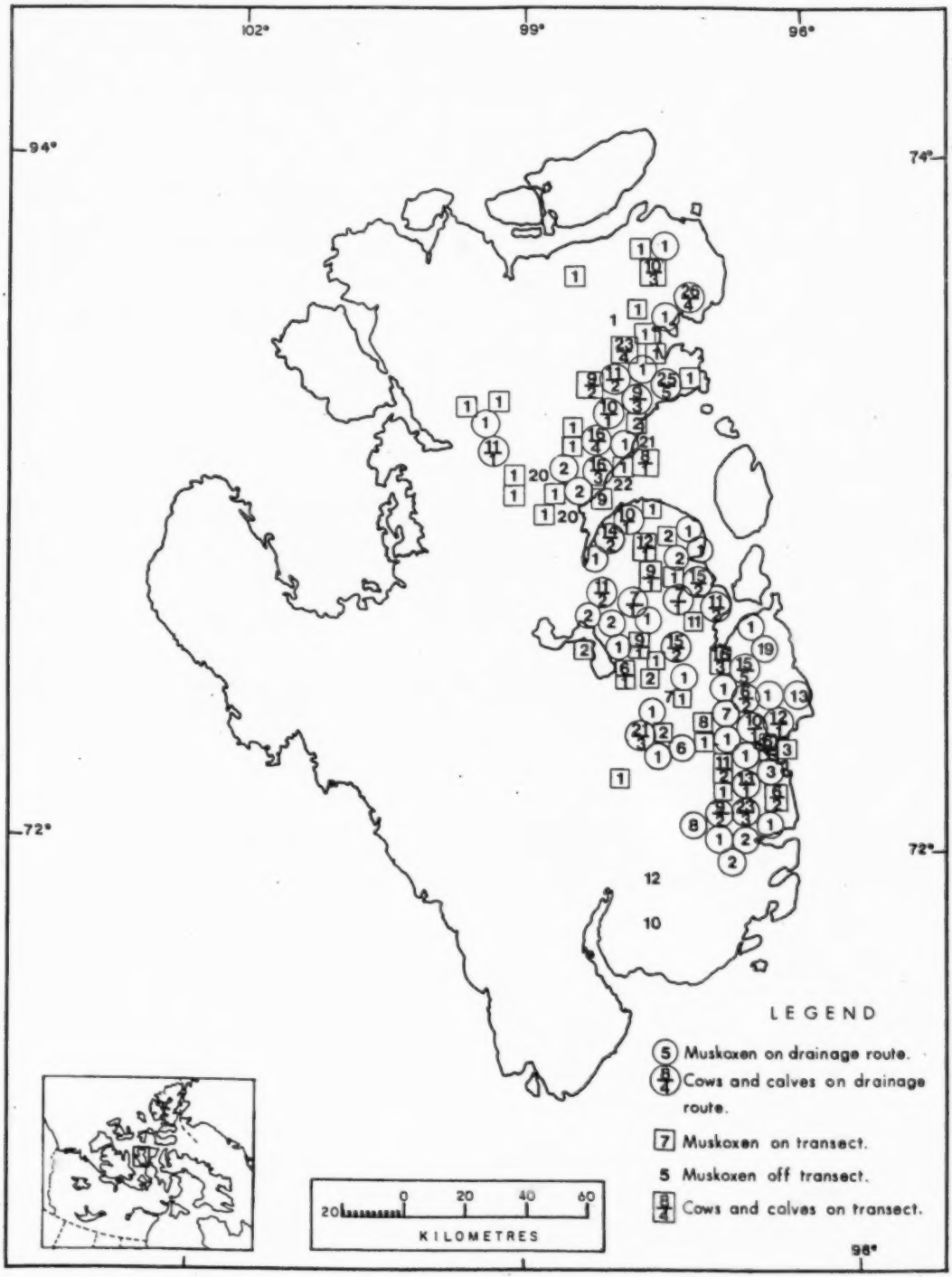

Figure 7. Muskoxen located during transect and drainage surveys flown on Prince of Wales Island, NWT, July 1980.

composition, but 12 solitary bulls and bull groups, were scattered west of Crooked Lake. East of Crooked Lake we observed 15 groups of mixed composition and 19 solitary bulls or bull-only groups. In Stratum I, the nine groups of mixed composition were all within 16 km of the east coast, as were 10 of the 19 solitary bulls and bull-only groups. As in Stratum II, solitary bulls and bull groups in Stratum I were more scattered in distribution than were groups of mixed composition.

Mean group sizes of mixed muskox groups were slightly larger in Stratum I (Table 8). The proportion of all groups that was solitary bulls in Stratum I was 66.7% compared to 45.5% in Stratum II. The proportion of total groups that were single sex groups (bull-only) was 15.2% in Stratum II and only 5.5% in Stratum I. In the mixed sex groups, proportion of calves was 12.1% (10/83) in Stratum I (Appendix A) and 9.8% (17/174) in Stratum II (Appendix B).

We flew 1560 km on Prince of Wales Island during the survey of drainages and coastal areas on 23 July 1980 (Fig. 8). Reference to identifiable topographic features suggested our visual strip width was 2-5 km, so the area search was approximately 6240 km^2. We counted 439 muskoxen in 49 groups, including 17 solitary bulls, 6 bull groups and 26 mixed sex groups.

In comparing the sightings made during the drainage survey with the transect survey flown 10 days previously, we have made two assumptions. Counts of individual groups during the transect survey were less accurate because we did not circle the herds.

Table 8. A summary of grouping statistics of muskoxen on Prince of Wales Island, July 1980.

Grouping statistics	Strata I	Strata II
Mixed sex		
No. groups (muskoxen)	5 (69)	13 (147)
Mean ± SD	13.8 ± 7.6	11.3 ± 3.4
Range	9-27	7-19
Single sex		
No. groups (muskoxen)	1 (2)	5 (12)
Mean	2	2
Range	2	2-3
Solitary bulls		
No.	12	15

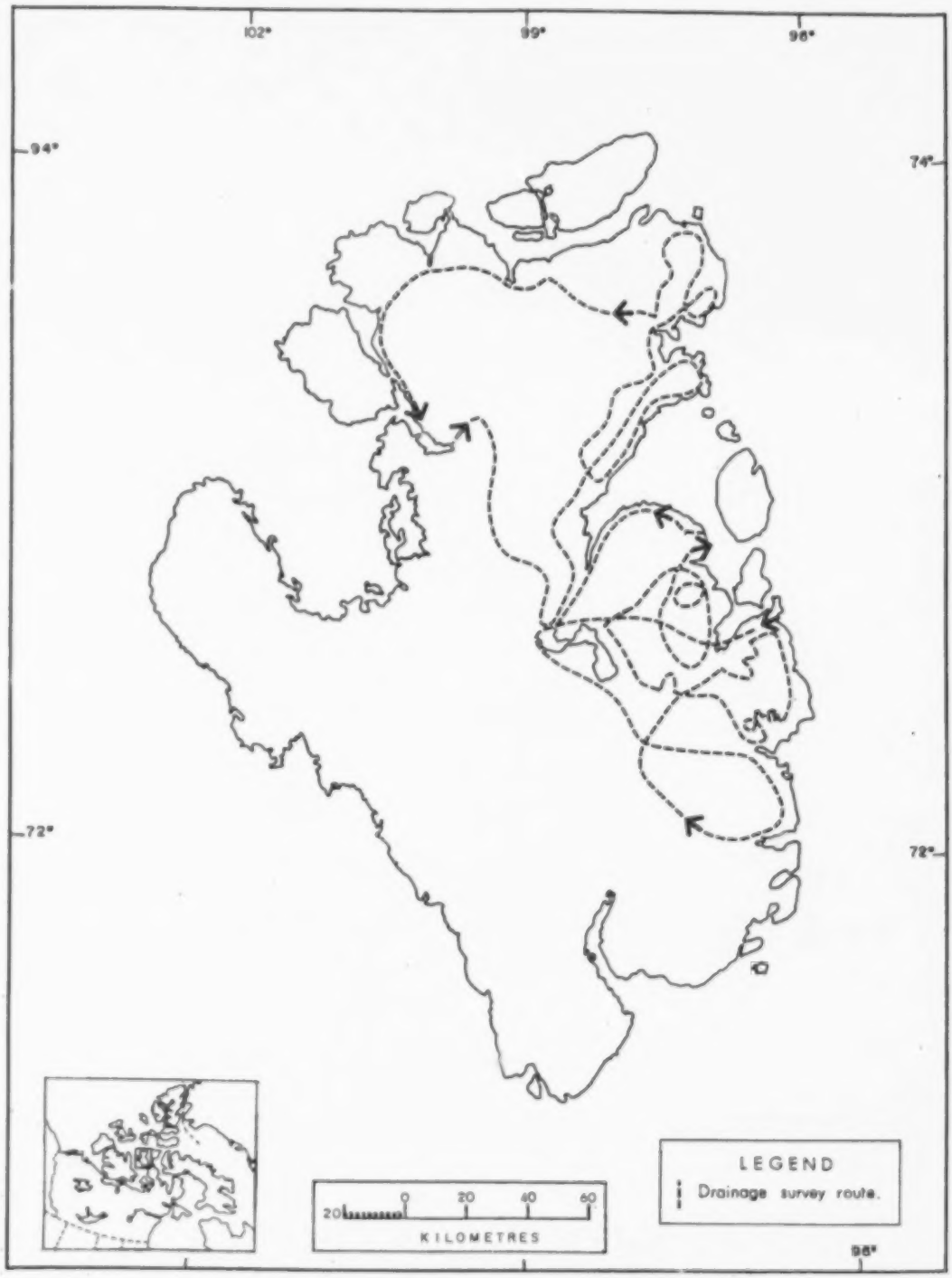

Figure 8. Route of muskox drainage survey flown on Prince of Wales Island, NWT, July 1980.

Secondly, we assumed that the herds had not moved more than 16 km in the 10-day period between the two surveys. Comparisons of herd size, number of calves, and locations of herds between the two surveys enabled us to arrive at a count of 543 muskoxen in the area east of 99°N and north of 72°W (Fig. 6).

The area covered by the drainage and coastal survey was approximately 12,000 km^2; survey coverage was approximately 50%. The coverage by the transect survey was 33% (Stratum I) and 17% (Stratum II). During the transect survey, 295 muskoxen (193 on transect, 102 off transect) were counted in the same area, compared to 439 on the drainage survey.

Herd size and composition were compared for the same herds observed on the drainage survey and the transect survey. During the drainage survey we circled them at high altitude (300 m agl). During the transect survey, the herds were flown by, or over, at 150 m agl. Of the 13 herds compared, only 3 were counted at the same size (herds of 8, 7 and 19). The counts of individual herds differed by 1, 2 or 3 individuals (either adults or calves). More calves (25) were counted during the drainage survey than during to the transect survey (18). The count of 1+year-old muskoxen was higher during the transect survey (161) than the drainage survey (158). The total number in the combined groups was 179 (161+18 calves) on the transect survey and 183 (158+25 calves) from the drainage survey.

The lower number of calves observed on the transect survey compared to counts of the same herds circled during the drainage survey also shows up in a comparison of all groups counted during

both surveys of the same areas. Of the 295 muskoxen observed during the transect survey, 7.5% were calves but 11.4% of the 439 muskoxen counted during the drainage survey were calves. Both types of surveys counted similar numbers of groups but the proportion of solitary bulls seen on the transect survey (51.0%, 25 of 49) was greater than that seen on the drainage survey (35.3%, 18 of 51). The proportion of calves in the 24 mixed groups counted during the transect survey is 8.4% (22/237) compared to 12.3% (50/408) in the 33 mixed groups counted during the drainage survey.

DISCUSSION

Caribou

The high densities of wintering caribou on Prince of Wales, Russell and Somerset Islands are found on the rugged coastal areas of west Somerset. Wintering caribou are also found on the Somerset east coast south of Creswell Bay, and are scattered on Prince of Wales. In late May and June changing snow conditions precipitate movement from Somerset to Prince of Wales across the sea ice (Miller et al. 1982). Relatively few caribou summer on Somerset Island in the Creswell River basin and coastal areas south of Creswell Bay. The proportion of the caribou that seasonally migrates across the sea ice is unknown; however, track counts suggest at least 1000 caribou crossed in spring of 1978 (Miller et al. 1982). Many of those caribou move up the east coast of Prince of Wales to the northeast, where they funnel through northwest-southeast running valleys or around the coast to the north and then move west and south. Some caribou summer on Russell Island.

That anti-clockwise movement concentrates the caribou on the "Mt. Clarendon Peninsula", which is a potentially calving area. Consecutive counts by the Canadian Wildlife Service in 1980 support the identification of the area as a calving area (F.L. Miller pers. comm.). The Plains of Arrowsmith may be a calving or post-calving area as suggested by relatively high densities of cow-calf pairs there in June-July 1975 (Fischer and Duncan 1976) and July 1980. Subsequent late summer, fall, and winter movements

of the caribou are not well understood. Eastward crossing of Peel Sound has been observed in November (Miller and Gunn 1980).

The hunter harvest of caribou is concentrated in late winter along the west coast of Somerset Island, with a few caribou being taken on Russell and Prince of Wales Islands. In the fall the caribou are also harvested on northern Prince of Wales and near the Creswell Bay area, Somerset Island. Estimates of the annual harvest are about 150-250 in the late 1970's and early 1980's.

As caribou are harvested on all three islands, and especially in the area from which the caribou make seasonal inter-island movements, it becomes necessary to combine the level of the kill and the population estimates for the three islands. The annual variations in productivity and the low calf survival (Miller and Gunn 1979, Thomas 1982) demand a low level of harvest over a period of several years, if the population is to be maintained at existing levels.

In June-July 1976, Miller and Gunn (1979) observed 2.2% yearlings and 18.8% calves in a total of 3939 sightings of caribou during behavioural studies. The proportions of calves among total numbers of caribou observed during aerial surveys in July and August were 22.5% in 1974, 25% in 1975 (Fischer and Duncan 1976) and 13% in 1980. The figures cannot be compared with calf proportions for mainland caribou as the proportion of pregnant cows varies between years according to the severity of the winter (Thomas 1982). During his studies on the relationship between body fat and pregnancy rates, Thomas (1982) recorded that 3 of 23 caribou collected in March-April 1977 were yearlings; 10 of 54 in

1976 and 7 yearlings were among the 46 caribou collected in 1977. Those samples cannot be realistically considered as measures of recruitment because of the small sample size. Additionally, the measure of calf survival (proportion of yearlings) in March and April may not indicate true recruitment because further mortality may occur as winter is not over until mid-June. The low calf survival suggested by the small proportion of short-yearlings in the 1976 summer may reflect the above average snowdepths of the 1975-76 winter as the pregnancy rate was also lower in 1976 compared to 1975 and 1977 when snowdepths were average.

The few data available for the population dynamics of Peary caribou on Prince of Wales and Somerset Islands suuggest that the population dynamics track the severity of winter weather through changes in pregnancy rates and mortality. The population may be relatively resilient to the effects of occasional severe winters as the high proportion of yearlings bred in some years (Thomas 1982) is indicative of a high recovery potential after a year of depressed productivity. The apparent absence of any major changes in population size between 1974-75 and 1980 does suggest the population cannot sustain any increase in harvest level over the current harvest level of 3-5% (harvest 150-250/year). Even relatively small changes in hunting practices, and or intensity, such as increased access to the caribou by use of aircraft, or establishment of more outpost camps, could rapidly and substantially alter the balance, especially if the changes in hunting coincide with one or more severe winters.

Aerial surveys in 1974 and 1975 (Tables 9 and 10) generated five population estimates, but these estimates cannot be easily compared with our 1980 estimate. The great difficulty of seeing the almost white Peary caribou against a background of snow means the population figures for June 1974 and April 1975 are likely under estimated (Table 10). The surveys in July 1974 and June 1975 were against snow-free backgrounds, but are still not strictly comparable to our survey. Strip width was visually estimated (and not marked on the aircraft); aircraft altitude was lower in July 1974 and June 1975 (90 m agl versus 150 m agl) than in July 1980, and we tended to fly more slowly (140-190 kmph versus 150-220 kmph). These three factors probably improve the accuracy of our survey, as does the greater coverage (5.1%-8.3% in July 1974, 8.8%-16.7% in June 1975 compared to 17.5%-31.2%), but that improvement cannot be quantitified. The combined estimates for Prince of Wales, Russell and Somerset Islands in July 1974 (5,841) and June 1975 (4,760) are likely low. Comparison with the July 1980 estimate (4926±762) suggests a stable or, possibly, a slightly declining caribou population.

The Peary caribou on Prince of Wales, Russell and Somerset Islands are almost the only caribou population accessible to the people of Resolute Bay and associated outpost camps. The population also represents a significant proportion of the world's population of Peary caribou (Gunn et al. 1981). There has been no evidence of a recovery of Peary caribou numbers in the High Arctic (Gunn et al. 1981, M. Ferguson pers. comm., Thomas and Joly 1982). The severe late-winter conditions in 1982 may have further

Table 9. Previous linear transect surveys of Peary caribou and muskoxen on Prince of Wales and Somerset Islands, July 1974-1976.

Year	Month	Coverage	Source
Prince of Wales Island			
1974	June 18	10.1%	Fischer and Duncan 1976
	July 29-30	5.1%-8.3%	Fischer and Duncan 1976
1975	April 4-14	8.6%	Fischer and Duncan 1976
	April 13-16	11.8%	C. Elliott, Wildlife Service Files
	June	8.8%-16.7%	Fischer and Duncan 1976
1976	July 2, August 18-24	50.0%	T. Chowns, Wildlife Service Files
Somerset Island			
1974	June 3-9	25.3%	Fischer and Duncan 1976
1975	March 18-30	9.3%	Fischer and Duncan 1976
	April 6-10	20%	C. Elliott, Wildlife Service Files
	June 23-24	9.3%	Fischer and Duncan 1976

Table 10. Estimates of Peary caribou and muskoxen on Prince of Wales, Russell and Somerset Islands from aerial surveys, 1974-76.

Date	Coverage (%)	Number of caribou on transect	Number of caribou estimated	Number of muskoxen on transect	Number of muskoxen estimated
Prince of Wales					
1974 June	10.1	105	1040	57	564
July	6.7	445	5437	51	872
1975 April	10.0	236	2360	281	2381
April	8.6	50	581	78	907
June	12.7	404	3768	37	313[1]
1976 July	50.0			172	--
Russell					
1975 April		6			
April	7.1	0	0		
June	15.7	25	159		
July	15.7	14	89		
Somerset					
1974 June	25.3	62	245		
1975 March	9.3	60	645		
April		123			
June	9.3	84	903		

1 Only east half of island surveyed

precluded any possible recovery of the population. The estimate of about 5000 caribou for Prince of Wales, Russell and Somerset has to be reviewed in the context of about 7500 Peary caribou on Banks Island in June 1982 (P. Latour pers. comm.), 4500 on northwestern Victoria Island in July 1980 (Jakimchuk and Carruthers 1980) and an unknown population on the High Arctic Islands, which likely does not exceed 3000-4000 (Gunn et al. 1981).

Resolute Bay is a logistical base for many of the oil, gas and mining companies that are increasing their activities in the High Arctic. Although industrial activities increase the number of people with jobs, the increased cash also improves the efficiency of hunting activities as hunters can buy modern equipment. There is a possibility that such projects as the Arctic Pilot Project and Polaris mine will lead to increased hunting pressure directly, by allowing purchase of modern equipment, or indirectly as some people reject the development-induced changes and return to live off the land. The fragmentary data on productivity, recruitment, and population trends suggest that any increased harvesting of the Peary caribou on Prince of Wales, Russell and Somerset Islands will lead to a decline in the population.

Among the caribou summering on Prince of Wales is an unknown proportion of caribou from Boothia Peninsula. In 1977 and 1978 we observed caribou trails on the sea ice between Boothia Peninsula and southeastern Prince of Wales (Miller and Gunn 1980). In winter, small, white caribou have been identified on Matty Island

(between King William Island and Boothia Peninsula) in 1938 (Manning and Macpherson 1961), on the Boothia Peninsula in 1977 (D.C. Thomas pers. comm.), and on Gateshead Island in 1982 (D.C. Williams pers. comm). Thus movement from Prince of Wales is known, but the extent and regularity of these movements are not. Nor is the taxonomy of all the caribou on Prince of Wales fully documented, as the movements between the mainland and possibly Victoria Island may have led to some mixing with R. t. groenlandicus. In August 1978, five mature caribou bulls were collected. Their average weight was 230 kg, which considerably exceeds body weights for R. t. pearyi and even for R. t. groenlandicus. Though skull measurements and appearance were closer to pearyi than groenlandicus, they were not typically pearyi.

Muskoxen

Considerably less is known about the biology, (especially productivity), and population age structure of muskoxen on Prince of Wales. Many of the data gaps exist because no collections have been made of muskoxen on that island.

The concept of what constitutes a muskox population compared to an arbitrarily defined "management zone" population has barely been addressed in discussions of muskox management (Gunn 1982). On an island such as Prince of Wales with no distinct climatic or vegetative zones, it is reasonable to refer to all the muskoxen as one population. Comparisons of distributions observed during late winter and summer surveys (Fischer and Duncan 1976), and

distributions of winter and summer fecal pellets (Russell et al. 1978), suggest that the muskox population on Prince of Wales does not have geographically separate winter and summer ranges. Russell et al. (1978) noted that muskoxen primarily fed on sedge meadows located on coastal lowlands and valley floors for most of the year, except in early summer when they moved to adjacent drier sites with Salix communities.

Estimates from surveys in 1974 and 1975 varied (Tables 9 and 10), but Fischer and Duncan (1976) believed that there were approximately 600 muskoxen on Prince of Wales. Both Renewable Resources (Fischer and Duncan 1976) and B. Hubert (1975) flew systematic linear transect surveys in April 1975, a period when muskoxen are conspicuous against the snow background. Fischer and Duncan (1976) counted 78 muskoxen on transect (4-14 April 1975) and estimated a population of 907± based on 8.6% coverage. Hubert (1975) flew a survey of 11.8% coverage (13-16 April 1975) and counted 281 muskoxen, which would extrapolate to an estimated population of 2381.

The results of our drainage survey and our local knowledge of the muskox population lead us to believe that the lower level of population estimate from the transect survey is closer to reality. The estimate of 1126±276 (S.E.) at the lower level is 850 muskoxen. Transect surveys are not usually considered to generate reliable estimates if the study population is highly clumped. As muskoxen are social animals, and form groups that are then clumped by habitat dispersion, alternate techniques to transect surveys are required.

The drainage survey, if standardized with a fixed flight altitude and strip width, could be regarded as a non-linear transect survey, or could be used as the basis for a block survey of high density areas. As muskox distribution, especially at high densities, seems to be so strongly correlated with drainages and coastal areas in summer, a block survey based on topography and vegetation may be the most effective and precise technique. In winter, muskox distribution may be more influenced by the distribution of well-vegetated slopes with shallow snow cover. If this is the case, a different technique perhaps relying more on transects may be more applicable. Further investigation into winter habitat preferences and their relation to distribution would likely lead to improvement in survey techniques.

Muskoxen are relatively easily observed especially against a snow background, though counting of individuals can be confounded if the muskoxen group together. Flight altitudes of 300-500 m agl reduce that problem, and 35 mm photography could be used as a check for counts of muskoxen in large groups that are more likely to be encountered in winter (Miller et al. 1977).

T. Chowns (1976), in response to requests for a muskox quota from the residents of Resolute Bay, flew a linear transect survey of eastern Prince of Wales in August 1976 (Tables 9 and 10). The comparison of muskox numbers counted (Table 10) on several surveys in the same area (Fischer and Duncan 1976, Hubert 1975, this report) is complicated by the different rates of coverage. Population estimates cannot be extrapolated, as the off-transect observations cannot be separated from the on-transect

observations, with the data presented in the reports. Fischer and Duncan (1976) commented that snow patches remained on the ground during the June 1974 survey. If the same conditions applied in June 1975, the low counts might reflect the difficulties of spotting dark muskoxen against a background patched with white and dark. The data in Table 10 do, however, suggest that the muskox population is stable or slightly increasing.

The muskox population on Prince of Wales was probably the same size or slightly larger in July 1980 than it was in 1974 and 1975. The calf crop in July 1974 was 7% (7/101) during the transect survey and 14.0% (43/306) during an aerial spotcheck. The figures for 1975 were 11% (9/81) and 15% (14/95), respectively (Fischer and Duncan 1976). In August 1976, Chowns (1976) counted 38 calves among 286 muskoxen during an aerial survey. His percentage value of 13.3% increases to 15.0% when only mixed composition groups are considered in the sample. This is still lower than the figure of 21.4% (33/154) obtained from ground counts during behavioural studies in July-August 1976 (Miller and Gunn 1979). The calf count in July-August 1977 (30.7%) was high, but may reflect a small sample size (5 groups; 39/126). The ground counts in 1976 and 1977 suggest that the recruitment of yearlings is low. In July 1976 and 1977, it was 4.0% and 4.8%, respectively.

The northern two-thirds of Prince of Wales Island are in muskox management area A/1-4. From 1977 to the present time this area has had an annual quota of three bulls and three cows (1 October to 31 March) allocated to Resolute Bay. The southern

muskox management area, B/3-1, has had a quota of two bulls and one cow allocated to Spence Bay. Although the hunters from Resolute Bay take their quota, the hunters from Spence Bay have not (A. Helmer pers. comm.). The hunters identified the dates of the season (1 August to 31 March) as the reason for not hunting muskoxen. Ice conditions are not suitable for travel to Prince of Wales until mid-winter and even by 31 March it is not light enough to travel such a long distance (A. Helmer pers. comm.).

The arguments for not extending the season beyond 31 March are two-fold. First, the most likely problem resulting from hunting, especially from snowmobiles, is abandonment of newborn calves. Newborn calves (probably to several weeks of age) cannot keep up if the herd bolts even a short distance. Abandoned calves can be lost through wolf predation (B. Bergman pers. comm.), imprint themselves to the hunting party (especially if the calf is only days old and not totally imprinted on its mother) or starve. Attempts to reunite the calf with the herd are usually unsuccessful. The second argument is that enforced running of near-term cows, which is probably inevitable with hunting by snowmobile, could lead to abortion or birth complications. Births have been recorded in March, April, May and June, though most calves are born in April and May.

There is no biological reason for the hunting season to begin in the two management units during different months, i.e., 1 October in A/1-4 and 1 August in B/3-1. The hunting of muskoxen during the rut (August) should probably be discouraged to avoid unnecessary interruptions of rutting behaviour.

Although they are sketchy the muskox population data showing low recruitment and a stable or slightly increasing population (1974-80), suggest that only minor increases in the quota can be considered unless the possibility of population decrease is acceptable. If a quota increase is requested, a relatively small increase possibly not to exceed six bulls could be set. This would double the northern quota. We lack the biological data to set a quota that would track environmental conditions. Most quotas are managed by hind-sight insofar as a quota is acceptable as long as a population does not obviously decline.

The small muskox population of Somerset Island should not be hunted. The historical population levels are unknown, other than that muskoxen were present. Russell et al. (1978) found about 24 skulls piled in one site near the Union River in 1975 which suggests muskoxen were previously hunted on Somerset Island. There is no evidence that the over-wintering whalers or explorers hunted muskoxen but conjectually, the Inuit drawn to the area by the presence of whales and traders could have lead to the killing of a small muskox population. Russell et al.'s (1976) sighting of a herd of 12 muskoxen including three calves in 1975 was the first recent sighting of muskoxen (none were seen in 1974 or 1975 during Renewable Resources' surveys). The muskoxen were periodically seen and by 1980 numbered 29 though in July 1980 we saw no calves. In 1981, the larger herd presumably split. Sightings in 1981 and 1982 refer to two herds of 12-15 muskoxen each and a pair of bulls (D. Grant pers. comm.).

The scarcity of muskoxen, even historically, on Somerset Island and the Boothia Peninsula suggest that those areas may represent the eastern extent of the muskox range. The data presented by Russell et al. (1979) describe potential summer ranges on Somerset Island and/or Boothia Peninsula; but average snow depths may be approaching the limits for successful populations as snowfall increases east and south of Prince of Wales Island (Maxwell 1980).

There are practical problems in combining the description of distributions and numbers of caribou and muskoxen in the same survey. The design of our survey was more suited for the measurement of the caribou population. The stratification was based on expected caribou distribution. The timing was such that the caribou still moulting their white winter pelage, were at maximum contrast with the snowfree background, and the flight altitude and transect width were more suitable for caribou. A different design would be more effective for a muskox survey, including a higher flight altitude (300-500 m agl to reduce the likelihood of muskoxen bunching together and to allow a wider transect) and snow-covered gound.

Our survey conditions were favourable: both observers were experienced; the duration of flights did not exceed 3 h and fatigue was not a problem as the choice of plane (Helio-Courier with large wheels) facilitated landing, the pilot was highly experienced in flying transect surveys in the High Arctic and we had good visibility conditions during the survey (Appendix G). There was no significant difference between the two observers in the numbers of muskoxen and caribou counted.

We have not corrected for observer bias. The current state of knowledge about observer bias and corrections would only allow a token correction. Previous attempts to measure observer bias are highly questionable (eg., Fischer and Duncan 1976). Moreover they do not have a standardized approach to the many different survey conditions of background, lighting, animal density and weather likely to be encountered. We suggest that the quantification and understanding of the sources of observer bias along with survey design, are still among the most important problems in providing basic information for big game management.

RECOMMENDATIONS

Caribou

1. The number of caribou killed from Prince of Wales, Russell and Somerset Islands should be closely monitored.

2. Fall and late winter weather records from Resolute Bay should be monitored. If conditions such as fall icing or late winter heavy snow accumulation occur, the Resolute Bay H.T.A. should be advised that the caribou will likely be stressed by those conditions and a reduced calf crop, low recruitment and even increased mortality may result.

3. If the kill by humans (a) increases, or (b) remains at the same level (150-250) during one or more years of unusually severe weather, a population survey should be carried out.

4. This population survey should cover Prince of Wales, Russell and Somerset Islands. Stratification should be based on the known distribution for early-mid July. The survey should be flown at this time as the caribou pelage will have maximum contrast to the background conditions.

5. The northwestern portion of Mt. Clarendon and the Arrowsmith Plains on Prince of Wales Island are important calving areas. The west coast and Stanwell Fletcher basin on Somerset Island are important wintering areas. Persons

planning field camps and activities, including those regulated by Land Use Regulations should be advised on the importance of avoiding disturbance in those areas.

Muskoxen

1. If requested, the quota for management unit A/1-4 could be increased by six bulls. The apparently stable population (1974-80) and low recruitment suggest that the quota should remain small.

2. The closing dates (31 March) for the muskox hunting in A/1-4 and B/3-1 should not be extended to prevent accidental calf abandonment and pregnancy complications.

3. The opening date of muskox hunting in B/3-1 should be changed from 1 August to 1 October to minimize disturbance during the rut.

4. No muskox quota should be established on Somerset Island.

5. A theoretical evaluation and field tests of designs for muskox surveys are necessary before further surveys are carried out.

ACKNOWLEDGEMENTS

The surveys were funded by NLUIS Program (Department of Indian and Northern Affairs Canada) and the N.W.T. Wildlife Service. Polar Continental Shelf Project gave logistical assistance and Canadian Wildlife Service provided base camp facilities. F.L. Miller (CWS), advised on survey design and procedures and, with J. Edmonds (CWS) assisted as observers during the muskox drainage survey. The judgements and experience of P. Linton (Nahanni Air) in flying aerial surveys in the High Arctic contributed to our success. We thank E. Irvine for patient help in producing, and M.A. Bromley for editing the report.

PERSONAL COMMUNICATIONS

Bergman, B., Wildlife Officer, N.W.T. Wildlife Service, Fort Smith, N.W.T.

Eckalook, G., Resolute Bay, N.W.T.

Ferguson, M., Regional Biologist, N.W.T. Wildlife Service, Frobisher Bay, N.W.T.

Grant, D., Bradley Air Services, Resolute Bay, N.W.T.

Helmer, A., Wildlife Officer, N.W.T. Wildlife Service, Pine Point, N.W.T.

Latour, P., Regional Biologist, N.W.T. Wildlife Service, Inuvik, N.W.T.

Miller, F.L., Research Scientist, Canadian Wildlife Service, Edmonton, Alberta.

Thomas, D.C., Research Scientist, Canadian Wildlife Service, Edmonton, Alberta.

Williams, D.C., Wildlife Officer, N.W.T. Wildlife Service, Cambridge Bay, N.W.T.

LITERATURE CITED

Chowns, T. 1976. The muskox population of eastern Prince of Wales Island, N.W.T. N.W.T. Wildl. Serv. unpubl. report. 3 pp.

Dunbar, M. and K.J. Greenaway. 1956. Arctic Canada from the air. Can. Def. Res. Board. 541 pp.

Fischer, C.A. and E.A. Duncan. 1976. Ecological studies of caribou and muskoxen in the arctic archipelago and northern Keewatin, 1975. Rep. for Polar Gas Environ. Prog. 1975. 194 pp.

Gunn, A. 1982. Muskox. Ch. 51 In: Chapman, J.A. and G.A. Feldhamer, (eds.), Wild Mammals of North America: Biology, management and economics. Johns Hopkins University Press, Baltimore. 1147 pp.

Gunn, A., F.L. Miller and D.C. Thomas. 1981. The current status and future of Peary caribou Rangifer tarandus pearyi on the arctic islands of Canada. Biol. Conserv. 19:283-196.

Hubert, B. 1975. Caribou and muskox survey, Prince of Wales and Somerset Islands. Data and maps on file with N.W.T. Wildlife Service.

Jakimchuk, R.D. and D.R. Carruthers. 1980. Caribou and muskoxen on Victoria Island. Rep. prep. for Polar Gas Project by R.D. Jakimchuk Management Associates Ltd, Sidney, B.C. 93 pp.

Manning, T.H. and A.H. Macpherson. 1961. A biological investigation of Prince of Wales Island, N.W.T. Trans. Roy. Can. Inst. 33(3):116-239.

Maxwell, J.B. 1980. The climate of the Canadian Arctic Islands and adjacent waters. Vol. I Climatological Studies 30. Atmospheric Environ. Serv. Toronto. 531 pp.

Miller, F.L. and A. Gunn. 1979. Responses of Peary caribou and muskoxen to helicopter harassment. Can. Wildl. Serv. Occas. Pap. No. 40. 90 pp.

Miller, F.L. and A. Gunn. 1980. Inter-island movements of Peary caribou (Rangifer tarandus pearyi) south of Viscount Melville Sound and Barrow Strait, Northwest Territories, Canada. Pages 99-114 In: Reimers, E., E. Gaare, and S. Skjenneberg, (eds.), Proc. 2nd Reindeer/Caribou Symp. Rørøs, Norway, 1979. Direktoratet for vilt og ferskvannsfisk, Trondheim. 799 pp.

Miller, F.L., E.J. Edmonds and A. Gunn. 1982. Foraging behaviour of Peary caribou in response to springtime snow and ice conditions. Can. Wildl. Serv. Occas. Pap. No. 48. 41 pp.

Miller, F.L., R.H. Russell and A. Gunn. 1977. Peary caribou and muskoxen on western Queen Elizabeth Islands, N.W.T., 1972-1974. Can. Wildl. Serv. Rep. Ser. 40. 54 pp.

Russell, R.H., E.J. Edmonds and J. Roland. 1978. Caribou and muskoxen habitat studies. Arct. Isl. Pipeline Rep. ESCOM Rep. No. A1-26. 140 pp.

Treude, E. 1975. Studies in settlement development and evolution of the economy in the east Central Canadian Arctic. Can. North Almanac. 1:53-66.

Thomas, D.C. and P. Joly. 1981. Status of Peary caribou on the western Queen Elizabeth Islands in April 1980. Musk-ox 28:58-64.

Thomas, D.C. 1982. The relationship between body fat and productivity of Peary caribou. Can. J. Zool. 60(4): 597-602.

Woo, V. and S. Zoltai. 1977. Reconnaissance of the soils and vegetation of Somerset and Prince of Wales Islands. Northwest Territories Inf. Rep. No.X-X 186. Nor. For. Res. Centre, Edmonton, Alberta. 127 pp.

Appendix A. Numbers of Peary caribou and muskoxen observed on transect (1.6 km wide) on Stratum I, Prince of Wales Island, July 1980.

Transect no.	Transect area km^2	Caribou observed		Muskoxen observed	
		Left	Right	Left	Right
4	33.3	0	0[1]	0	0
5	76.8	0	2+2	0	0
6	71.7	0	4	0	1
7	87.1	4+2	1	0	0
8	104.9	14+3	2	1	10+3
9	122.9	4+2	0	0	44+7
10	125.4	2	25+6	1	0
11	133.1	0	0	0	9
12	135.7	14	45+6	0	0
13	143.4	5	4	3	0
14	140.8	2	28+12	0	0
15	140.8	11	5	0	1
16	138.2	4	1	0	0
17	128.0	0	2+2	0	2
18	143.4	38+2	12+2	0	0
19	153.6	61+7	44+18	0	0
20	158.7	6	23+4	0	1
21	176.6	16+2	15+3	0	0
22	176.6	10+2	10	0	0
23	128.0	25+4	10	0	0
24	130.6	5	10+2	0	0
25	115.2	3	20+4	0	0
26	84.5	11+5	2	0	0
27	87.1	18+2	25+5	0	0
28	46.1	5+2	9+1	0	0
29	46.1	4	25+5	0	0
30	10.2	0	3+3	0	0
Total	3,039	262+33	327+75	5	68+10

1 2+2 is two 1+year-old animals + 2 calves.

Appendix B. Numbers of Peary caribou and muskoxen observed on transect (1.6 km wide) on Stratum II, Prince of Wales Island, July 1980.

Transect no.	Transect area km^2	Caribou observed		Muskoxen observed	
		Left	Right	Left	Right
44	78.8	2	0	0	0
45	92.2	0	0	0	0
46	100.0	1	0	0	0
47	115.2	7	2	0	0
48	89.6	123+10	25+10	1	0
49	82.0	5	9+3	0	0
50	102.4	7+1	9	1	0
51	128.0	12+1	23+8	0	0
52	179.0	1	16+5	1	3
53	194.6	17+2	14+3	0	0
54	238.2	17+1	12+5	0	0
55	279.0	31+6	27+7	0	6
56	284.2	5+1	0	0	10
57	302.0	8	11+1	0	0
58	281.6	1	0	3	23+4
59	243.2	22	7	0	9+1
60	248.4	7+2	3+3	13+1	3
61	248.4	0	21+4	3	21+1
62	209.8	5+2	1	0	0
63	174.0	2	3	28+4	19+3
64	166.4	5+2	0	0	12+3
Total	3,837.0	178+28	183+49	51+5	106+12

1 23+10 is 23 1+year-old animals + 10 calves.

Appendix C. Numbers of Peary caribou observed on transect (1.6 km wide) on Strata I and II, Somerset Island, July 1980.

Transect no.	Transect area km^2	Caribou observed	
		Left	Right
Stratum I			
1	33.3	0	0
2	117.8	0	0
3	184.3	0	0
4	189.4	0	0
5	204.8	0	0
6	207.4	3	0
7	202.2	0	0
8	186.9	7	0
Total	1,326.1	10	0
Stratum II			
16	181.8	0	0
17	189.4	0	0
18	186.9	0	0
19	125.4	0	0
20	53.8	2	6+4
Total	737.3	2	6+4

1 6+4 is 6 1+year-old animals + 4 calves.

Appendix D. Numbers of Peary caribou observed on transect (1.6 km wide) on Strata III and IV, Somerset Island, July 1980.

Transect no.	Transect area km^2	Caribou observed	
		Left	Right
Stratum III			
22	108.8	7+5	8+2
23	105.6	0	1
24	96.0	0	4
25	89.6	0	5
26	66.6	1	0
27	20.5	0	0
Total	487.1	8+5	18+2
Stratum IV			
28	41.0	0	3
29	51.2	0	0
30	81.9	3	0
31	110.1	0	0
32	120.3	24	14+6
33	128.0	2	0
34	117.8	0	0
35	117.8	0	0
36	115.2	2	0
37	110.1	0	0
38	133.1	34+6	7+2
39	107.5	3	1+1
Total	1,234.0	68+6	25+9

1 7+5 is 7 1+year-old animals + 5 calves.

Appendix E. Numbers of Peary caribou observed on transect (1.6 km wide) on Russell Island, July 1980.

Transect no.	Transect area km^2	Caribou observed	
		Left	Right
33	15.4	0	6
34	28.2	8	6
35	33.3	6	0
36	35.8	27+1	
37	38.4	1	17+8
38	35.8	0	0
39	35.8	8	18+8
40	33.3	5	25+4
41	33.3	1+1	0
42	17.9		2
43	12.8	3	9
Total	320.0	59+2	142+22

Appendix F. Survey conditions.

Date	Hours flown	Weather conditions	Subjective visiblity rating[1]
9 July	8.3	Ferry flight from Norman Wells	-
10	-	Fog all day	-
11	-	Fog and overcast	-
12	5.7	Broken cloud, 600 m agl base, few rain squalls	Bright
13	8.2	Overcast to broken, 600 m agl base	Bright to dull
14	11.9	Overcast to broken, 600+ m agl base	Dull to bright
15	8.4	Thin overcast to broken, 600-700 m agl base	Bright
16	-	Fog	-
17	2.8	Overcast, fog banks: abandoned attempt	Dull
18	6.3	Snow showers, broken cloud	Bright
19	7.8	Broken cloud, snow squalls	Bright
20	5.4	Overcast, 400 m agl to broken in squalls	Dull to bright
21	10.3	Broken cloud, 300 m agl, rain squalls	Bright
22	7.4	Broken 400 m agl	Bright
23	10.5	Broken 300 m agl	Bright
Total	93.6		

1 Subjective rating based on contrast of caribou and muskoxen against their background, "dull" implies lack of contrast and no shadows.